

## SECONDARY LATCH/VERIFIER FOR A QUICK CONNECTOR

### Background of the Invention

5           This invention relates to fluid line systems which include quick connector couplings, and more particularly to a quick connector coupling having a secondary latch/verifier.

          In automotive and other fields, quick connector couplings, which generally include a male member received and sealingly retained in a female connector body, are often utilized to provide a fluid connection between two components or conduits, thus establishing a fluid line  
10   between the two components. Use of quick connector couplings is advantageous in that a sealed and secured fluid line may be established with a minimum amount of time and expense.

          A number of methods and mechanisms exist for securing the male member and female connector body of a quick connector coupling together. One type of retention mechanism involves the use of a retainer disposed within the connector body. The retainer has load-bearing  
15   members extending between a radial face formed within the connector body and an enlarged upset formed on the male member, thereby securing the male member within the connector body. One drawback of this type of retainer is that separation of the coupling is usually difficult to attain. A special release tool or sleeve is often required to disconnect the joint.

          Another type of retention mechanism involves use of a retainer in the form of a retention  
20   clip inserted through slots formed in the exterior of the connector body. Beams extending through the slots are poised between the male member upset and the rearward surfaces defining the slots, thereby preventing disconnection of the coupling. Due to the physical appearance of such retainers, they are referred to in the trade as "horseshoe" retainers. An example of this type of retainer is found in U.S. Patent No. 5,586,792, to Kalahasthy et al., which is herein

incorporated by reference. The "horseshoe" retainer, disclosed in the '792 Patent, permits easy release of the coupling without significantly increasing the complexity of the coupling. The quick connector coupling of the present invention is an improvement of the type of retainer disclosed in the '792 Patent by using a secondary latch/verifier which prevents unintentional  
5 release of the coupling, provides verification that the coupling is properly connected and prevents the disconnection of the coupling should the primary horseshoe retainer fail.

### Brief Description of the Drawings

Fig. 1 is an exploded view of a quick connector coupling according to the present  
10 invention;

Fig. 2 is a perspective view of the female connector body of Fig. 1;

Fig. 3 is a side view of the female connector body of Fig. 2;

Fig. 4 is a rear view of the female connector body of Fig. 2;

Fig. 5 is a sectional view of the connector body of Fig. 4, taken through line 5-5;

15 Fig. 6 is a sectional view of the connector body of Fig. 3, taken through line 6-6;

Fig. 7 is a front view of the primary retainer of Fig. 1;

Fig. 8 is a side view of the primary retainer of Fig. 7;

Fig. 9 is a rear view of the primary retainer of Fig. 5;

Fig. 10 is a perspective view of the secondary latch/verifier of Fig. 1;

20 Fig. 11 is a top view of the secondary latch/verifier of Fig. 10;

Fig. 12 is a rear view of the secondary latch/verifier of Fig. 10;

Fig. 13 is a side view of the secondary latch/verifier of Fig. 10;

Fig. 14 is a sectional view of the connector body of Fig. 1 with sealing elements in the sealing chamber;

Fig. 15 is a side view of the coupling of Fig 1, with the primary retainer in the locked position and the secondary latch/verifier in the unlatched position;

5 Fig. 16 is a sectional view of the coupling of Fig. 15, taken through line 16-16;

Fig. 17 is a sectional view of the coupling of Fig. 1, with the primary retainer in the locked position and the secondary latch/verifier in the latched position; and

Fig. 18 is a sectional view of the coupling of Fig. 1, with the primary retainer in the released position and the secondary latch/verifier in the unlatched position.

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#### Detailed Description of the Drawings

Figure 1 illustrates a quick connector coupling 10 formed in a fluid line. The coupling 10 is comprised of a generally cylindrical female connector body 12 and a male member 14 secured together by a primary retainer 16 and a secondary latch/verifier 18. The male member 14 is  
15 formed at an end of a hollow tube which forms a part of a fluid line system. In use, the female connector body 12 is connected to a tubing or hose 13 (as illustrated in Fig. 14) which is also a part of the fluid line system. The female connector body 12 and the male member 14 are connectable to form a permanent, but severable, joint in the fluid line.

The connector body 12 is illustrated in detail in Figures 2-6. The connector body 12 is  
20 defined by a generally cylindrical, stepped exterior wall 20 and a generally cylindrical, stepped interior wall 22. The connector body 12 is centered about an axis 24, and is preferably made of a plastic material, such as polyamide. The interior wall 22 defines a through bore 26. The bore 26

extends completely through the connector body 12, from a larger diameter, male member reception end 28 to a smaller diameter, hose connection end 30.

Variations in the diameter of interior wall 22 of connector body 12 divide bore 26 into four distinct sections. Moving axially inward from the male member reception end 26 to the hose connector end 30, they are: retainer housing section 32, seal chamber 34, tube end receptacle 36, and fluid passageway 38.

The retainer housing section 32 is adjacent to the male member reception end 28. It is defined by a C-shaped outer rim 40 connected to an inner rim 42 by a top support member 44, two side support members 46,48, two center support members 50,52, and two bottom support members 54,56. An outer rim slot 41 is defined at the bottom of the C-shaped outer rim 40. A notch 43 is defined at the bottom of the inner rim 42. The spaces between the top support member 44 and the two side support members 46,48 define two top slots 58,60. The spaces between the two side support members 46,48 and bottom support members 54,56 define two side slots 62,64. The space between the two bottom support members 54,56 defines a bottom slot 66. The top slots 58,60 receive and position the primary retainer 16 transversely to the central axis 24 of the connector body 12. The side slots 62,64 and the bottom slot 66 receive and position the secondary latch/verifier 18 transversely to central axis 24 of the connector body. The top support member 44 defines a curved upper surface 45. Each of the center support member 50,52 defines a locking shoulder 68,70. A locking ridge 72,74 extends laterally from the outer edge of each bottom support member 54,56.

The seal chamber 34 is formed axially inward of the retainer housing section 32. It is defined by a reduced diameter portion of interior wall 22, relative to the retainer housing section 32, extending axially inward from a conical shoulder 78 to a radial shoulder 80. The seal

chamber 34 is provided to house sealing elements to form a fluid seal between the connector body 12 and the male member 14.

The tube end receptacle 36 is formed axially inward of the seal chamber 34. It is defined by a reduced diameter portion of interior wall 22, relative to seal chamber 34, which extends axially inward from the small diameter end of radial shoulder 80 to a conical shoulder 82. The tube end receptacle 36 is provided to receive an open end of the male member 14.

The fluid passageway 38 is defined by the smallest diameter portion of interior wall 22. It leads from the small diameter end of conical shoulder 82 to hose connection end 30. The portion of exterior wall 20 surrounding fluid passageway 38 is configured to facilitate connection to another component in the fluid line. The illustrated connector body 12, for example, is specially formed for connection to a flexible hose. A conical nose 84 is formed adjacent end 30 to facilitate insertion into a flexible hose, and ramped barbs 84 are formed outward of nose 84 to retain the hose on the connector body. A groove 88 is defined to house an exterior O-ring seal, if desired.

Alternative exterior configurations could be employed around the fluid passageway end of connector body 12 for connection to other system arrangements. Threads, for example, could be formed in exterior wall 20 to facilitate connection within a threaded bore of a housing containing a system component.

As illustrated in Figure 1, the male member 14 is formed at the end of a rigid tube. It includes a radially enlarged upset 90 formed a given distance from an open tube end 92. The tube end 92 can be rounded or tapered to make insertion of the male member 14 into the connector body 12 less difficult. A smooth, cylindrical sealing surface 94 extends between the

upset 90 and the tube end 92. The outer diameter of sealing surface 94 should be such that the end of male member 14 fits snugly within the tube end receptacle 36.

The primary "horse-shoe" type retainer 16 is illustrated in detail in Figures 7-9. It is preferably made of a resilient, flexible material, such as plastic. The primary retainer 16, which extends through the top slots 58,60 of retainer housing section 32, is demountably coupled to the connector body 12.

The primary retainer 16 includes a pair of elongated, generally parallel legs 96 extending from, and joined at one end by, a cross member 98. The cross member 98 provides a separation between the legs 96 approximately equal to the non-upset outer diameter of the male member 14. The legs 96 have an axial width approximately equal to, but slightly less than (to allow clearance), the axial width of the top slots 58,60. The lateral width of the legs 96 is significantly less than the lateral width of the top slots 58,60, in order to allow outward expansion of the legs 96 (to permit male member insertion and release).

The cross member 98 has an axial width substantially greater than that of the legs 96. As illustrated in Figure 8, the cross member 98 is axially aligned with the front faces 102 of the legs 96, but extends axially beyond the rear faces 104 of the legs 96.

Each leg 96 includes a latch 106 formed at an end remote from the cross member 98, a release protrusion 108 formed on the rear face 104 at an end adjacent to the cross member 98, and a sloping lead area 110 formed on the front face 102 between the latch 106 and the cross member 98. When the primary retainer 16 is fully inserted into the connector body 12, the latches 106 lock the primary retainer 16 into position relative to the connector body 12. Latching edges 112, defined by the latches 106, engage the locking shoulders 68,70, defined by the center support members 50,52 of the connector body 12, to lock the primary retainer 16 in place.

The release protrusions 108 protrude from the rear face 104 of each leg 96, just below the cross member 98. The release protrusions 108 extend axially from the legs 96 a distance approximately equal to the distance by which cross member 98 extends axially from the legs 96. Ramped or camming surfaces 114 are formed on each protrusion 108. When assembled, the  
5 ramped surfaces 114 rest just above the curved upper surface 45 of the top support member 44 of the connector body 12. If pressure is applied to the cross member 98 to press the primary retainer 16 further into the connector body 12, the ramped surfaces 114 contact and slide or cam against the top support member 44. Consequently, the legs 96 spread apart, allowing release of the male member 14.

10 The lead areas 110 slope radially and axially inward from the front face 102 of each leg, and terminate approximately midway between the front face 102 and the rear face 104. The spacing between the lead areas 110 is at its greatest adjacent the front face 102. Here, the spacing is approximately equal to the diameter of the upset 90 formed on the male member 14. At the rear edges 116 of the lead areas 110, the spacing between the lead areas 110 is  
15 approximately equal to the (non-upset) outer diameter of the male member 14. The portions of the lead areas 110 closer to the latches 106 curve inwardly at 118 to match the annular profile of the male member upset 90. This assists in guidance and centering of the male member 14 through the connector body 12.

The secondary latch/verifier 18 is illustrated in detail in Figures 10-13. It is preferably  
20 made of a resilient, flexible material, such as plastic. The secondary latch/verifier 18 includes a retainer beam 119, and a pair of elongated, generally parallel fingers 122 joined by a connecting member 124. The connector member 124 defines a rectangular shaped notch 125. The notch 125 is shaped to allow a knifed edge having a rectangular shaped cross-section, such as the end

of a screw drive, to be inserted therein to provide the leverage necessary to pry the secondary latch/verifier 18 from the latched position (as illustrated in Fig. 17) to the non-latched position (as illustrated in Fig. 16.) Extending axially from the front of the retainer beam 119 is a tube verifier 126. Extending axially from the rear of the connecting member is a retaining rim 128.

5           The retainer beam 119 includes a laterally enlarged portion 120 and a narrowed portion 121. The lateral width of the enlarged portion 120 is slightly less than the lateral width of the bottom slot 66. The lateral width of the narrowed portion 121 is slightly less than the lateral width of the outer rim slot 41. The enlarged portion 120 defines an abutment surface 123 for abutment with the upset 90 of the male member 14. The radially inner surface of the retainer  
10 beam 119 is curved to match the curvature of the outer surface of the tube forming the male member 14.

Each finger 122 includes a hook 130 formed at an end remote from the connecting member 124. Notches 132, defined by the hooks 130, engage the locking ridges 72,74, defined by the bottom support members 54,56 to secure the secondary latch/verifier 18 to the connector  
15 body 12 when the secondary latch/verifier is in an unlatched positioned. Located between the hooks 130 and the connecting member 124, the inner surface of each finger 122 defines a ramped surface 134 and a laterally enlarged surface 136. The distance between the ramped surfaces 134 of the two fingers is smaller than the distance between the locking ridges 72,74. The distance between the laterally enlarged surfaces 136 of the two fingers is approximately  
20 equal to the distance between the locking ridges 72,74. Furthermore, the narrowest distance between the inner surfaces of the fingers 122 is slightly greater than the distance between the outer surfaces of the legs 96 of the primary retainer 16. The axial width of the fingers 122 is approximately equal to the axial width of the legs 96.

The tube verifier 126 is generally moon shaped. The radially inner surface of the tube verifier 126 has a first curved surface 138 and a second curved surface 140. The first curved surface 138 is curved to match to curvature of the outer surface of the tube forming the male member 14. The second curved surface 140 is curved to match the curvature of the outer surface of the upset 90.

The retaining rim 128 extends axially from the rear of the connecting member 124. A rib 142 connects the front surface of the retaining rim 28 to the rear surface of the connecting member 124. The lateral width of the rib 142 is slightly smaller than the lateral width of the notch 43 of the inner rim 42. The axial length of the rib 142 is slight larger than the axial thickness of the inner rim 42. An edge 144 is defined at the radially inward edge of the retaining rim 128. The curvature of the edge 144 matches the curvature of the portion of the exterior wall surrounding the seal chamber 34. The curvature of the edge 144 is curved to allow upward pressure to release secondary latch/verifier into unlatch position and servicing of male member.

As illustrated in Figure 14, disposed within the seal chamber 34 are two O-ring seals 146,148 separated by a rigid spacer ring 150. The O-rings 146,148 are sized to fit tightly within the seal chamber 34 and tightly around the sealing surface 94 of the male member 14. The O-rings 146,148 are secured in the seal chamber 34 by a hollow spacer sleeve 152. The spacer sleeve 152 has a conically enlarged end 154 which seats against the conical shoulder 78 of interior wall 22 to position the sleeve 152 within bore 26. To provide enhanced securement of the spacer sleeve 152 within the bore 26, a raised annular portion 156 is formed in the outer periphery of sleeve 156, and a corresponding annular recess 158 is formed in the interior wall 22 (see Fig. 5). The raised portion 156 would be matingly received in the recess 158 formed in the interior wall 22 to lock the sleeve 152 into place.

Prior to inserting the male member 14 into the connector body 12, the primary retainer 16 is first attached to the connector body 12. The legs 96 of the primary retainer 16 are inserted through the top slots 58,60 of the retainer housing section 32. The primary retainer 16 is oriented such that the cross member 98 and the release protrusions 108 are located above the top support member 44, and the lead areas 110 of the legs 96 face the male member reception end 28.

Insertion of the legs 96 through the top slots 58,60 is facilitated by applying a downward force on the cross member 98. "Downward force" as defined in this patent application is a force that is applied toward the connector body 12. An increase in downward force is necessary when the legs 96 contact the sides of center support members 50,52. Applying sufficient downward force, the rounded ends of the legs 96 slide against the sides of the center support members 50,52, spreading the legs 96 apart and allowing the legs 96 to pass by the center support members 50,52. When the legs clear the center support members 50,52, the legs 96 spring inward with the latching edges 112 positioned under the locking shoulders 68,70 of the bottom support 78 to secure the primary retainer 16 to connector body 12. A properly attached primary retainer 16 is illustrated in Figures 15-17. In the attached position, the legs 96 of the primary retainer 16 are approximately perpendicular to the axis 24 of the bore 26 when viewed from the side (see Figs. 1 and 15). When viewed from the front or the rear, the legs 96 are approximately equally spaced from the axis 24 of the bore 26 (see Figs. 16 and 17).

With the primary retainer 16 properly attached to the connector body 12, the male member 14 is then inserted into the connector body 12. The sealing surface 94 of the male member 14 passes between legs 96 and into seal chamber 34 with little or no resistance, as the spacing between the legs 96 is approximately equal to the non-upset outer diameter of the male

member 14. Resistance to insertion occurs when the upset 90 of the male member 14 contacts the legs 96. The lead areas 110 of the legs 96 permit passage of the upset 90 between the legs upon applying sufficient axial inward force. As the upset 90 passes between legs 96, it rides along the lead areas 110 and flexes the legs 96 radially outward. Once the upset 90 has passed the legs, the legs 96 spring back into place behind the upset 90 to a locked position. The rear faces 104 of the legs 96 abut the upset to prevent subsequent inadvertent withdrawal of the male member 14 from the connector body 12. The spacer sleeve 152, along with the conical shoulder 78 defined on the interior wall 22 of the connector body 12, prevents further inward insertion of male member 130 from the locked position.

Release of the male member 14 from a locked position can be achieved by exerting a downward force on the cross member 98. Downward force on the cross member 98 causes the release protrusions 108 to contact the curved upper surface 45 of the top support member 44 of connector body 12. The ramped surfaces 114 of the release protrusions 108 slide or cam against the top support member 44, causing the legs 96 to spread laterally apart as application of downward force continues. Eventually, the legs 96 will be spread apart a distance sufficient to allow passage of the upset 90 between the legs 96. The male member 14 may then be withdrawn from the connector body 12. Upon withdrawal of the member 14 from the connector body 12 and relaxation of primary retainer 16, the primary retainer 16 reassumes to its normal installed position.

The coupling is completed by positioning the secondary latch/verifier 18 from a non-latched position, in which the locking ridges 72,74 are located within the notches 132, (as illustrated by Figs. 15 and 16) to a latched position (as illustrated by Fig. 17). To position the secondary latch/verifier 18 to the latched position, a downward force is applied to the connecting

member 124. With sufficient downward force, the ramped surfaces 134 of the fingers 122 slide against the sides of the locking ridges 72,74, spreading the fingers 122 apart and allowing the fingers to pass by the bottom support members 54,56. With the male member 14 properly inserted in the connector body 12, as illustrated in Figures 16 and 17, the secondary latch/verifier is able to move to a position where a section of the fingers 122 of the secondary latch/verifier 18 are located laterally outward of the legs 96 of the primary retainer 16. At the same time, the retainer beam 119 and the tube verifier 126 are moved radially inward toward the male member 14, and the retaining rim 128 is moved radially inward toward the exterior wall 20 surrounding the seal chamber 34.

When the secondary latch/verifier 18 is fully inserted into the connector body 12, the locking ridges 72,74 surpass the ramped surfaces 134 of the fingers 122 and are situated between the laterally enlarged surfaces 136. The fingers 122 of the secondary latch/verifier 18 spring laterally inward to the latched position as illustrated in Figure 17. The fingers 122 of the secondary latch/verifier 18 are approximately perpendicular to the axis 24 of the bore 26 when viewed from the side (see Figs. 1 and 15). When viewed from the front or the rear, the fingers 122 are approximately equally spaced from the axis 24 of the bore 26 (see Figs. 16 and 17). In the latched position, a portion of each finger 122 of the secondary latch/verifier 18 is positioned laterally outward of the corresponding leg 96 of the primary retainer 16. The position of the fingers 122 relative to the legs 96 prevents the legs 96 from inadvertently moving laterally outward to release the male member 14 from the locked position. In the latched position, the rear surface of the retainer beam 119 is in axial abutting relationship with the upset 90 of the male member 14. This axial abutting relationship between the retainer beam 119 and the upset

90 provides the secondary latch/verifier 18 with the secondary latch feature to retain the male member 14 in the connector body 12 should the primary retainer 16 fail.

The retaining rim 128 and the tube verifier 126 serve to position the secondary latch/verifier 18 to the connector body 12. In the latched position, the rib 142 extends through the notch 43 defined on the bottom of the inner rim 42. The retaining rim 128 is situated immediately axially rearward of the inner rim 42 of the connector body 12 and immediately radially outward of the exterior wall 20 surrounding the seal chamber 34. The connecting member 124 is situated immediately axially forward of the inner rim 42. The retaining rim 128 and the connecting member 124 of the secondary latch/verifier 18 sandwich the inner rim 42 to axially position the secondary latch/verifier 18 relative to the connector body 12. The narrowed portion 121 of the retainer beam 119 extends through the outer rim slot 41. The tube verifier 126 is situated immediately forward of the outer rim 40 of the connector body 12 and immediately radially outward of the tube forming the male member 14. Since the retaining rim 128 is situated immediately radially outward of the connector body 12 and the tube verifier 126 is situated immediately radially outward of the tube, the retaining rim 128 and the tube verifier 126 prevents the secondary latch/verifier 18 from tilting once it is in the latched position.

Figure 18 illustrates a situation when the male member 14 was not properly inserted into the connector body 12. In such a situation, the male member 14 has not been sufficiently inserted into the connector body 12 for the upset 90 to surpass the legs 96 of the primary retainer 16. With the legs 96 still spread apart, the fingers 122 of the secondary latch/verifier 18 are unable to be inserted radially inward into the connector body 12 since the ends of the fingers 122 will abut the still spread apart legs 96 of the primary retainer 16. Furthermore, with the male member 14 insufficiently inserted into the connector body 12, the upset 90 is located

immediately radially inward of the retainer beam 119 of the secondary latch/verifier 18.

Abutment of the radially inwardly surface of the retainer beam 119 with the radially outer surface of the upset 90 also prevents the secondary latch/verifier from being able to be inserted radially inward into the connector body 12. This inability of the secondary latch/verifier 18 from moving radially inward to the latched position provides verification to the user that the male member 14 has not been sufficiently inserted into the connector body 12. On the other hand, if the male member 14 has been sufficiently inserted into the connector body 12, such that the upset 90 has surpassed the legs 96 of the primary retainer 16, the ends of the fingers 122 of the secondary latch/verifier will not abut the legs 96 of the primary retainer 16 and the radially inwardly surface of the retainer verifier 119 will not abut the radially outer surface of the upset 90 allowing the secondary latch/verifier 18 to move to the latched position. This ability of the secondary latch/verifier 18 to move radially inward to the latched position provides verification to the user that the male member 14 has been sufficiently inserted into connector body 12.

Various features of the present invention have been explained with reference to the embodiment shown and described. It must be understood, however, that modification may be made without departing from the spirit of the invention and scope of the following claims.